SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade (III Cycle)
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

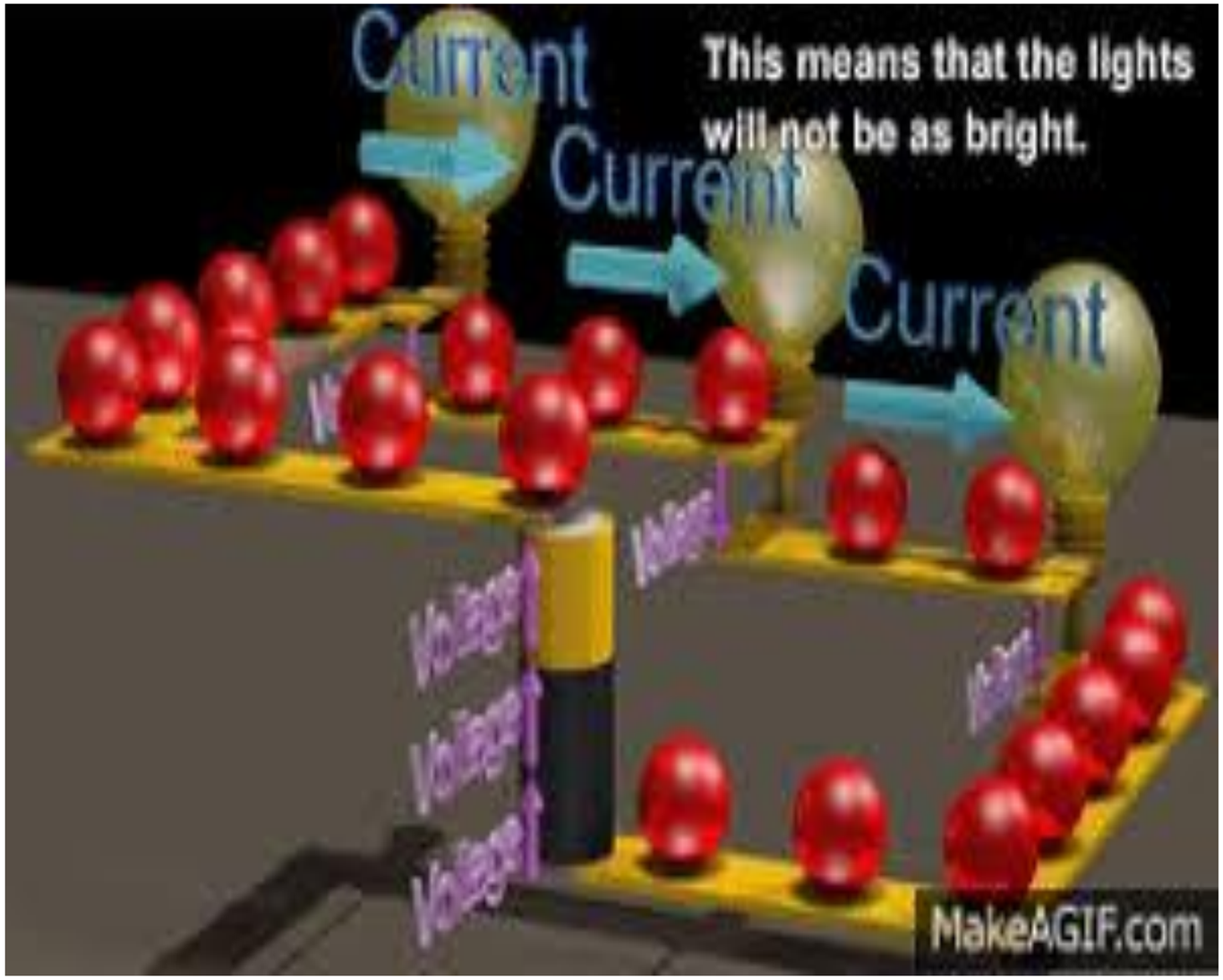
23ECB202 – LINEAR INTEGRATED CIRCUITS

II YEAR/ IV SEMESTER

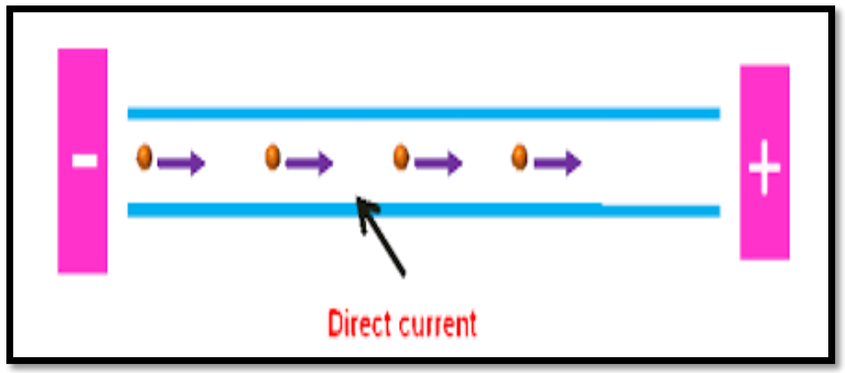
UNIT 2 – **APPLICATIONS OF OPERATIONAL AMPLIFIERS**

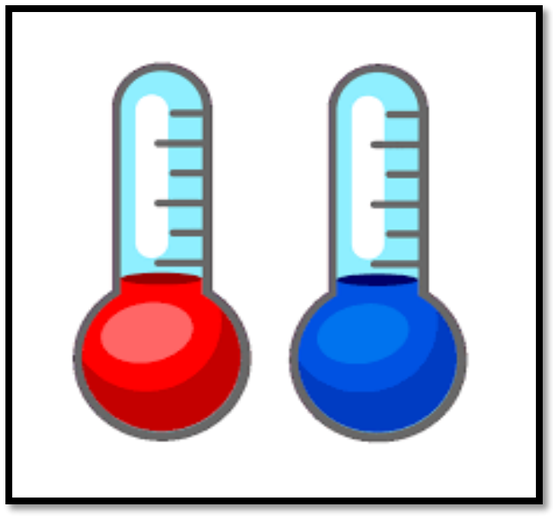
TOPIC 2 – V to I and I to V convertor

Guess?????


Current
This means that the lights will not be as bright.
Current
Current
Voltage
Voltage
Voltage
Voltage
MakeAGIF.com

Why?





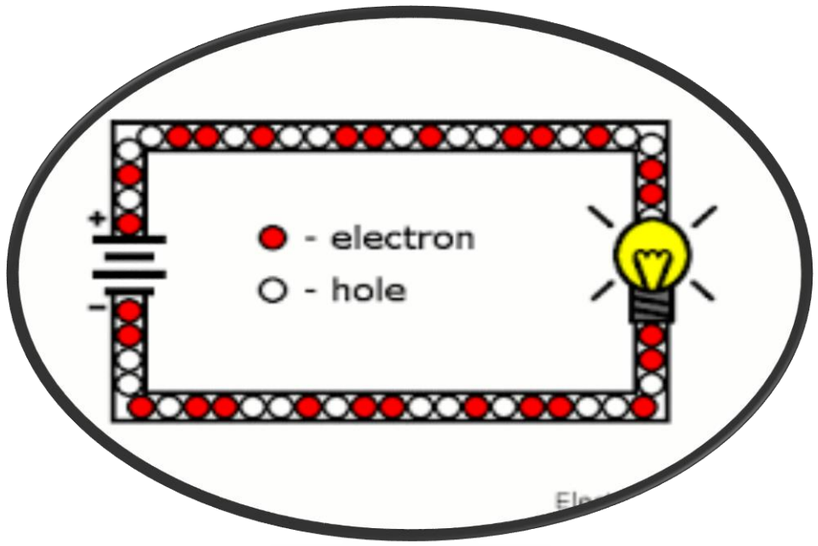
- In instrumentation circuitry, DC signals are often used as analog representations of physical measurements
- Temperature, pressure, flow, weight, and motion
- DC current signals will be constant throughout the circuit in series from the source to the load
- The current sensing instruments also have the advantage of less noise

Why?

➢So sometimes it is essential to create current which is corresponding or proportional to a definite voltage.

➢**Voltage to Current Converters** (also known as V to I converters) are used.

➢ It can simply change the carrier of electrical data from voltage to current.



Voltage to Current Converter

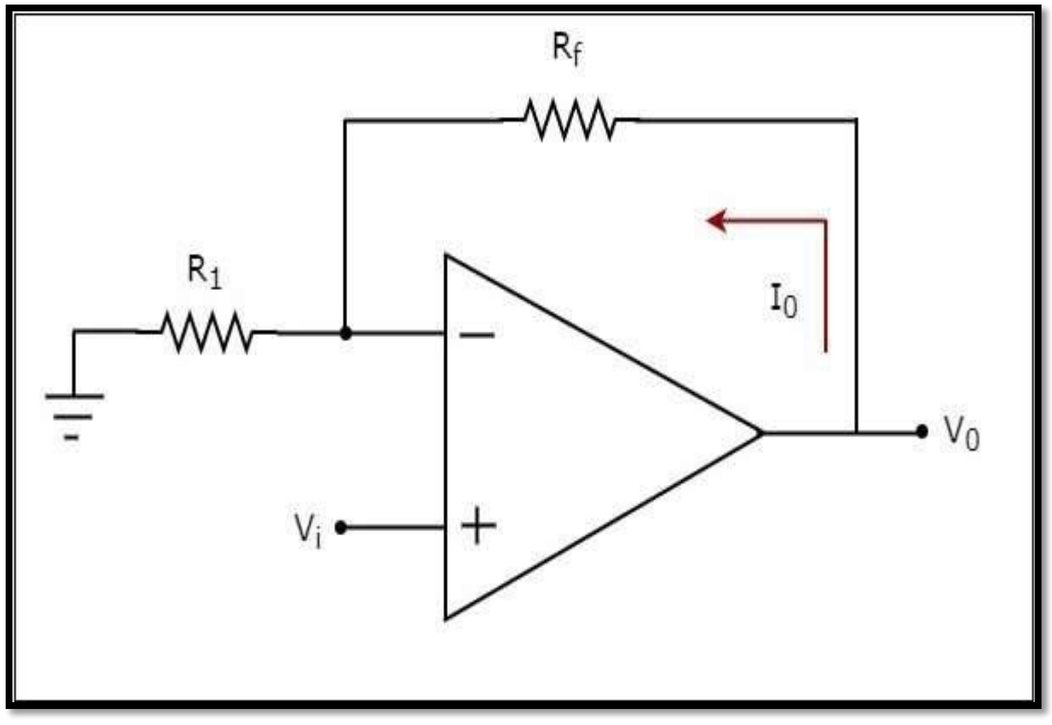
- A voltage to current (V-I) converter accepts as an input a voltage Vin and gives an output current of a certain value
- In general the relationship between the input voltage and the output current is

$$I_{out} = SV_{in}$$

Where S is the sensitivity or gain of the V-I converter

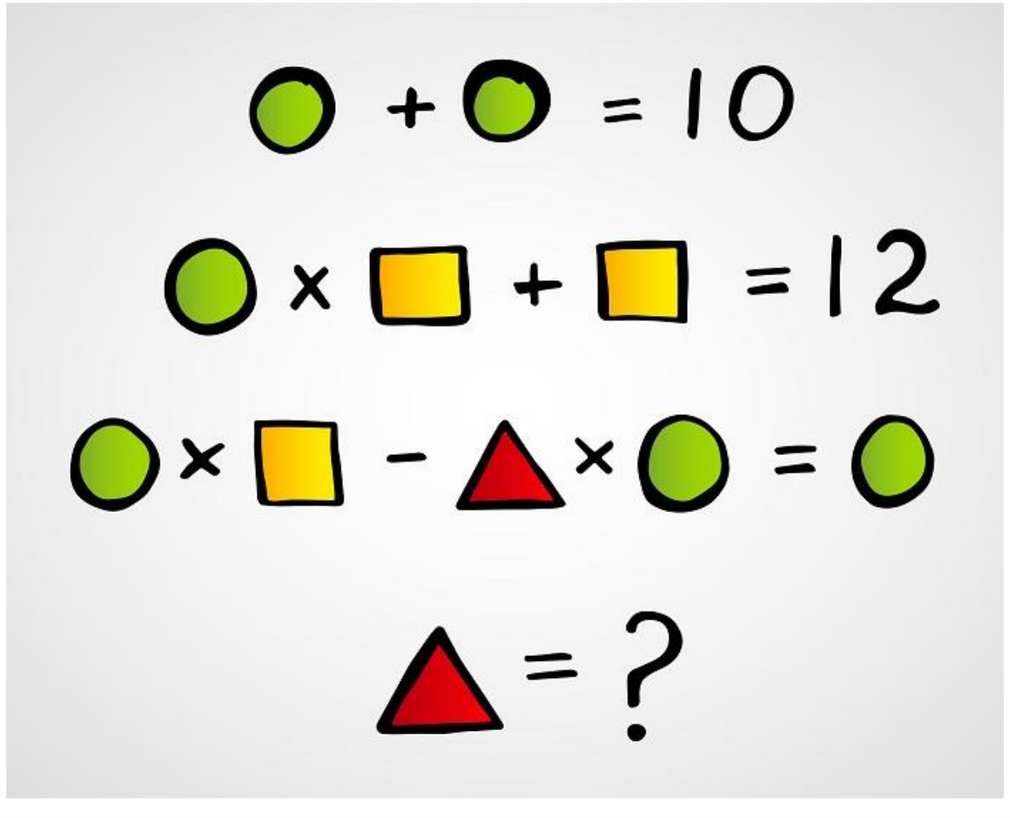
Voltage to Current Converter

- An op-amp based voltage to current converter produces an output current when a voltage is applied to its non-inverting terminal
- The **circuit diagram** of an op-amp based voltage to current converter is shown in the following figure



Activity

In class activity



Voltage to Current Converter

- In the circuit shown above, an input voltage Vi is applied at the non-inverting input terminal of the op-amp
- According to the **virtual short concept**, the voltage at the inverting input terminal of an op-amp will be equal to the voltage at its non-inverting input terminal .
- So, the voltage at the inverting input terminal of the op-amp will be Vi
- The **nodal equation** at the inverting input terminal's node is

$$V_i / R_1 - I_0 = 0$$

$$I_0 = V_i / R_1$$

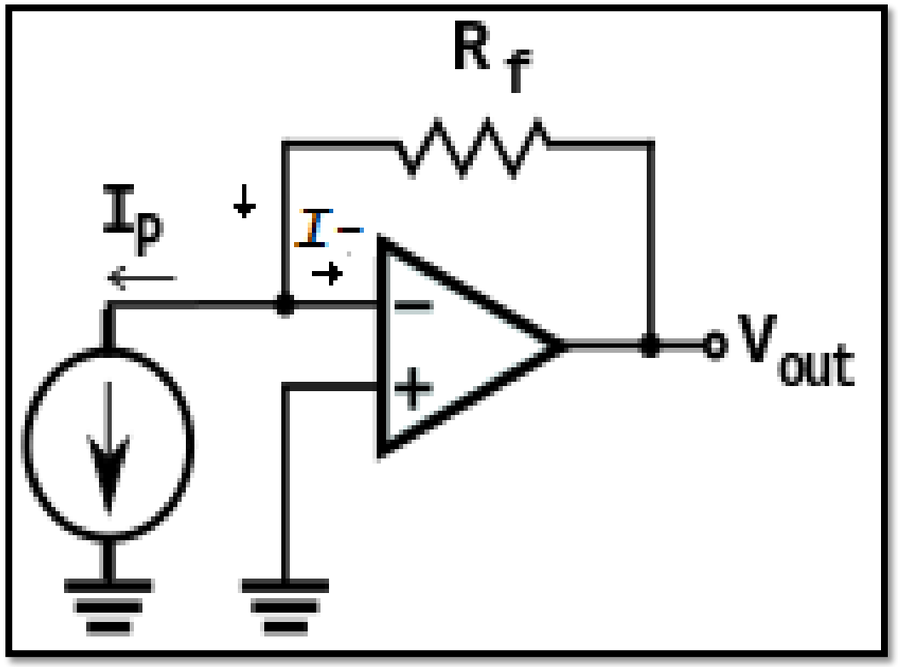
Voltage to Current Converter

- Thus, the **output current** I_0 of a voltage to current converter is the ratio of its input voltage Vi and resistance R_1

$$I_0 / Vi = R1$$

- The above equation represents the ratio of the output current I_0 and the input voltage Vi & it is equal to the reciprocal of resistance R_1
- The ratio of the output current I_0 and the input voltage Vi is called as **Transconductance**.
- Gain of an voltage to current converter is the Transconductance and it is equal to the reciprocal of resistance R1

Current to Voltage Converter



➢A current to voltage converter will produce a voltage proportional to the given current.

➢To analyse the current to voltage converter

➢If apply KCL to the node at V- (the inverting input) and let the input current to the inverting input be I-, then

❑Vout –V/ Rf = Ip+I

Current to Voltage Converter

The output is connected to V- through R_f

The opamp is in a negative feedback configuration

$$V-=V+=0$$

and assuming that I- is 0 and simplifying

$$Vout=Ip\ Rf$$

Sensitivity

Sensitivity of the I – V converter:

1. The output voltage $V_0 = -R_F I_{in}$

2. The gain of this converter is equal to $-R_F$. The magnitude of the gain (i.e) is also called as sensitivity of I to V converter

3. The amount of change in output volt ΔV_0 for a given change in the input current ΔI_{in} is decide by the sensitivity of I-V converter

4. By keeping R_F variable, it is possible to vary the sensitivity as per the requirements

Assessment

1.State the need for V to I convertor

THANK YOU